Demographic and Lifestyle Predictors of Survival in Patients With Esophageal or Gastric Cancers

KATRINA F. TRIVERS,*,† ANNECLAIRE J. DE ROOS,§ MARILIE D. GAMMON,*
THOMAS L. VAUGHAN,§ HARVEY A. RISCH,¶ ANDREW F. OLSHAN,* JANET B. SCHOENBERG,‖
SUSAN T. MAYNE,¶ ROBERT DUBROW,¶ JANET L. STANFORD,§ PAGE ABRAHAMSON,*
HEIDI ROTTERDAM,# A. BRIAN WEST,** JOSEPH F. FRAUMENI JR,† and WONG–HO CHOW†

*Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; †Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland; §Program in Epidemiology, Fred Hutchinson Cancer Research Center, Seattle, Washington; ¶Department of Epidemiology and Public Health, Yale University, New Haven, Connecticut; ‖Applied Cancer Epidemiology Program, New Jersey State Department of Health and Senior Services, Trenton, New Jersey; #Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York; **Department of Pathology, New York University School of Medicine, New York, New York

Background & Aims: **Risk factors for subtypes of esophageal and gastric cancer recently have been identified, but their effect on survival is unknown.** *Methods:* **Incident cases (n = 1142) from a population-based case-control study were followed-up from diagnosis (1993–1995) until 2000. Cox regression models were used to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) for esophageal and gastric cancer in relation to prediagnostic factors.** *Results:* **Relative to distant stage, esophageal adenocarcinoma (EA) patients with localized disease had a decreased risk for death (HR, .22; 95% CI, .15−.31), followed by those with regional spread (HR, .32; 95% CI, .23−.45). Similar patterns were seen for the other tumor types. Except for other (non-cardia) gastric adenocarcinomas (OGA), higher household income (≥$15,000/y vs. <$15,000/y) was associated with a 33%−38% decrease in risk for death. Prediagnosis body mass index (BMI) between 25 and 29.9 kg/m² was associated with longer survival for EA and OGA patients (EA: HR, .67; 95% CI, .51−.88) vs. BMI <25 kg/m². Women with esophageal squamous cell carcinoma (ES) and OGA experienced longer survival compared with men. Age, education, cigarette smoking, alcohol intake, gastroesophageal reflux disease, and nonsteroidal anti-inflammatory drug use did not consistently predict survival.** *Conclusions:* **Predictors of lengthened esophageal and gastric cancer survival included higher income (except in OGA), overweight (among EA and OGA patients), and female sex (among ES and OGA patients).**

Worldwide, gastric cancer is the second leading cause of cancer mortality.[1] Gastric cancer incidence is relatively low in the United States, but the burden is substantial, with 22,700 cases and 11,780 deaths estimated to occur in 2004.[2] Esophageal cancer is more lethal, with 14,250 cases and 13,300 deaths expected in 2004.[2] Tumor-specific risk factors have been identified including cigarette smoking, alcohol consumption, high body mass index (BMI), diet, *Helicobacter pylori* infection, gastroesophageal reflux disease, and limited use of nonsteroidal anti-inflammatory drugs.[3–8] Predictors of survival are not well characterized. Prognosis is poor, with 5-year relative survival rates between 15% and 21% for esophageal and gastric tumors, respectively.[2] Previous survival studies have focused on gastric cancer, indicating the importance of stage, grade, surgical treatment, and sex, whereas inconsistent results have been observed for race, education, and income.[9–16] Increased BMI and gastroesophageal reflux disease, risk factors for esophageal and gastric cardia adenocarcinoma,[4,8] have not been studied in relation to survival.

We sought to determine whether prediagnostic demographic, lifestyle, and anthropometric risk factors have prognostic significance for any of the tumor types.

Materials and Methods

Study Population

Patients were identified as part of a multicenter, population-based, case-control study of esophageal and gastric cancer. The study details have been described previously.[5] Incident invasive cases of esophageal adenocarcinoma (EA), gastric cardia adenocarcinoma, esophageal squamous cell carcinoma (ES), or other (non-cardia) gastric adenocarcinomas

(OGA), aged 30–79 years, and diagnosed between 1993 and 1995, were ascertained using rapid reporting systems in Connecticut, New Jersey, and western Washington state. Final case eligibility and tumor type was determined by 2 authors (H.R., A.B.W.) through standardized pathology review. Baseline interviews were completed for 80.6% of EA (n = 293) and gastric cardia adenocarcinoma (n = 261) patients, and 74.1% of ES (n = 221) and OGA (n = 367) patients.

Vital status and date of death were determined through the National Death Index, with maximum follow-up of 90 months. Survival time (in months) was calculated from the date of diagnosis through the date of death or last follow-up. A failure was defined as death from any cause during the follow-up period and patients alive at the end of the follow-up period were censored. Three patients were excluded from all analyses (2 patients lost to follow-up, 1 patient owing to a discrepancy between the date of diagnosis and death). Follow-up ceased in Washington state in July 2000, in New Jersey on September 15, 2000, and in Connecticut on October 28, 2000. All appropriate Institutional Review Boards approved this study.

Statistical Methods

Kaplan–Meier plots were used to determine univariate predictors of survival, and Cox proportional hazard regression analysis was used to build multivariable models and estimate hazard ratios (HRs; risk for death) and 95% confidence intervals (CIs). Separate models were run for each tumor type in relation to tumor characteristics assessed by medical record (Surveillance, Epidemiology, and End-Results program [http://seer.cancer.gov] summary stage, histologic grade) and prediagnostic lifestyle/demographic characteristics obtained from the respondent (within approximately 3 months of diagnosis), or a proxy (within approximately 8.5 months of diagnosis) (usual adult BMI, frequency of gastroesophageal reflux disease symptoms, and over-the-counter and prescription nonsteroidal anti-inflammatory drug use, household income, education, and tobacco and alcohol consumption). All were entered as dichotomous or indicator variables by using similar categories as in previous reports[5,8] except for BMI, which was categorized by using World Health Organization recommendations (overweight, ≥25 kg/m²; obese, ≥30 kg/m²).[17]

Multivariable HR models were constructed by using backward selection, and included variables that statistically significantly predicted survival or confounded another characteristic already present in the model. Referent groups were chosen so the majority of HR estimates would be less than 1. Results were not materially different when excluding proxy respondents (n = 355, 31%) or those with imputed income information (10%).

The potential confounding effect of cancer-directed surgery within 4 months of diagnosis as recorded by the Surveillance, Epidemiology, and End-Results program also was evaluated. In models based only among individuals with complete treatment data (n = 610), adjustment for surgery did not materially change any estimates. Thus, surgery was not included in

the models shown. Race (for ES and OGA only) was considered as a confounder, but did not alter any estimates.

No violations of the proportional hazards assumption were observed. Absolute differences in survival were calculated by comparing modeled (adjusted) median survival times across strata of covariates, which were evaluated at the reference level of all other variables in the model. Statistical significance was noted when the 2-sided P value was < .05.

Results

The majority of patients had regional or distant disease. Most patients completed high school, but made less than $30,000 per year (Table 1). The percentage of patients alive at the end of 7.5 years of follow-up ranged from 12% for ES to 20% for OGA (Table 1). Median survival times were 9.6 months (95% CI, 8.4–10.9 mo), 10.7 (95% CI, 8.9–12.6 mo), 12.8 (95% CI, 10.2–15.3 mo), and 12.9 (95% CI, 10.6–15.2 mo) for EA, ES, gastric cardia adenocarcinoma, and OGA, respectively.

In unadjusted models for all considered variables (Table 2), predictors of lengthened survival included low stage (for all tumor types), increased BMI (in EA and OGA patients), and household income greater than $15,000 per year (except in OGA). Table 3 highlights important predictors remaining after multivariable modeling. For all tumor subtypes, stage was the most important predictor of survival, with patients having lower-staged tumors experiencing a decreased risk for death relative to distant stage. Adjusted HRs for EA were .22 (95% CI, .15–.31) for localized and .32 (95% CI, .23–.45) for regional tumors. Estimates were similar for other tumor types, with decreased risks for death ranging from 60% to 88% for localized tumors, and from 51% to 65% for regional tumors.

Relative to households making less than $15,000 per year, higher income was associated with a 33%–38% decreased risk for death, except among OGA patients. When income was evaluated using multilevel variables, little variation in survival existed for categories greater than $15,000 and race did not confound the relationship (results not shown). In addition, women with ES and OGA had longer survival than men, with adjusted HRs of .57 (95% CI, .39–.83) and .77 (95% CI, .60–1.00), respectively.

Survival was most favorable in overweight EA and OGA patients (based on usual prediagnosis adult weight) relative to normal and underweight or obese patients (Table 3). Adjusted HRs for EA were .67 (95% CI, .51–.88) and .78 (95% CI, .55–1.12) for overweight and obese patients, respectively. Similar results were observed for overweight OGA patients. Alcohol drinking and cigarette smoking did not confound these relationships.

Table 1. Distribution (No. [%]) of Baseline Characteristics (at or Prediagnosis) Among Esophageal or Gastric Cancer Patients by Tumor Type in CT, NJ, and Western WA State, 1993–1995

Characteristic	EA (n = 293)	Gastric cardia adenocarcinoma (n = 261)	ES (n = 221)	OGA (n = 367)
Age (y)				
<50	35 (12.0)	38 (14.6)	18 (8.1)	30 (8.2)
50–59	56 (19.1)	48 (18.4)	32 (14.5)	49 (13.4)
60–69	83 (28.3)	86 (33.0)	90 (40.7)	104 (28.3)
70–80	119 (40.6)	89 (34.1)	81 (36.7)	184 (50.1)
Stage				
Localized	76 (25.9)	34 (13.0)	50 (22.6)	70 (19.1)
Regional	72 (24.6)	120 (46.0)	82 (37.1)	161 (43.9)
Distant	83 (28.3)	70 (26.8)	40 (18.1)	104 (28.3)
Unknown	62 (21.2)	37 (14.2)	49 (22.2)	29 (7.9)
Missing	0 (–)	0 (–)	0 (–)	3 (.8)
Tumor grade				
Well/moderate	120 (41.0)	97 (37.2)	95 (43.0)	101 (27.5)
Poor/undifferentiated	132 (45.1)	137 (52.5)	87 (39.4)	214 (58.3)
Not determined	37 (12.6)	26 (10.0)	37 (16.7)	42 (11.4)
Missing	4 (1.4)	1 (.4)	2 (.9)	10 (2.7)
Sex				
Women	48 (16.4)	38 (14.6)	45 (20.4)	114 (31.1)
Men	245 (83.6)	223 (85.4)	176 (79.6)	253 (68.9)
BMI (kg/m^2)				
<25	105 (35.8)	103 (39.5)	134 (60.6)	187 (51.0)
25–29.9	139 (47.4)	112 (42.9)	73 (33.0)	133 (36.2)
30+	49 (16.7)	46 (17.6)	14 (6.3)	47 (12.8)
Education				
<High school	65 (22.2)	56 (21.5)	88 (39.8)	117 (31.9)
High school+	227 (77.5)	204 (78.2)	133 (60.2)	249 (67.9)
Missing	1 (.3)	1 (.4)	0 (–)	1 (.3)
Household income ($/y)				
<15,000	60 (20.5)	41 (15.7)	71 (32.1)	87 (23.7)
15–29,999	87 (29.7)	81 (31.0)	75 (33.9)	115 (31.3)
30–49,999	69 (23.6)	65 (24.9)	56 (25.3)	100 (27.3)
50–74,999	42 (14.3)	37 (14.2)	9 (4.1)	45 (12.3)
75,000+	35 (12.0)	37 (14.2)	10 (4.5)	20 (5.5)
Survival				
Alive at end of follow-up period	38 (13.0)	40 (15.3)	26 (11.8)	75 (20.4)

Alternative categorizations of BMI (quintiles, separating normal and underweight patients) yielded essentially similar HR values but the confidence intervals were wider.

The modest HRs reflected a small number of months of additional survival for these demographic and lifestyle variables (results not shown). Stage was the strongest predictor of absolute survival; patients with localized disease had a median survival time of 2–7.5 months longer than those with distant disease. Other variables were associated with 1- to 2-month differences in median survival.

Discussion

In this multivariable evaluation of survival for patients diagnosed with a first primary esophageal or gastric cancer, tumor stage at diagnosis, as expected, was a strong predictor of survival after diagnosis. The more

favorable survival outcome among women rather than men with ES has been reported, but not in a multivariable analysis.[18–20] A male survival deficit has been reported in gastric cancer,[10,19] but was limited to OGA in our study.

EA and OGA patients with higher BMIs tended to have improved prognosis, but the relationship was complex (U-shaped), with overweight patients having longer survival compared with lighter and obese patients. Limited data are available from previous studies, with 1 study reporting a greater risk for recurrence of gastric cancer after surgery among patients with higher BMIs.[21] Our findings are noteworthy in view of the strong relationship between increasing BMI and the risk for developing esophageal adenocarcinoma,[8] as well as mortality from esophageal and gastric cancers.[22] It is unlikely that in this study BMI measurement or recall was impacted by disease development because BMI was queried soon

Table 2. Unadjusted HRs and 95% CIs for Demographic and Clinical Characteristics and Overall Survival Among Esophageal or Gastric Cancer Cases by Tumor Type in CT, NJ, and Western WA State (1993–1995 Through 2000)

	EA (n = 293)		GCA (n = 261)		ES (n = 220)		OGA (n = 366)	
	N[a]	HR (95% CI)	N[a]	HR (95% CI)	N[a]	HR (95% CI)	N[a]	HR (95% CI)
Stage								
Distant	83	1	70	1	40	1	104	1
Regional	72	.32 (.23–.45)	120	.49 (.36–.67)	82	.52 (.35–.77)	161	.37 (.29–.49)
Localized	76	.22 (.16–.32)	34	.20 (.12–.34)	49	.41 (.26–.64)	70	.12 (.08–.19)
Unknown	62	.40 (.28–.58)	37	.53 (.35–.82)	49	.47 (.30–.74)	29	.47 (.29–.74)
Grade								
Poor/undifferentiated	132	1	137	1	87	1	214	1
Well/moderate	120	.85 (.65–1.11)	97	.83 (.62–1.10)	94	1.16 (.85–1.58)	101	.68 (.51–.89)
Unknown	37	1.02 (.69–1.51)	26	.91 (.58–1.44)	37	1.40 (.93–2.10)	42	1.29 (.9–1.82)
Age (y)								
<50	35	1	38	1	18	1	30	1
50–59	56	.76 (.48–1.20)	48	.88 (.55–1.41)	32	.66 (.36–1.22)	49	.98 (.58–1.66)
60–69	83	.99 (.65–1.52)	86	1.04 (.68–1.58)	89	.72 (.42–1.22)	104	1.10 (.69–1.76)
70–80	119	1.01 (.67–1.51)	89	1.07 (.71–1.63)	81	.97 (.57–1.65)	183	1.08 (.69–1.69)
Sex								
Men	245	1	223	1	175	1	253	1
Women	48	.88 (.63–1.23)	38	1.18 (.82–1.69)	45	.61 (.42–.88)	113	.93 (.72–1.19)
BMI (kg/m²)								
<25	104	1	103	1	133	1	184	1
25–29.9	139	.65 (.50–.86)	112	.90 (.67–1.20)	72	.90 (.66–1.22)	132	.68 (.53–.87)
30+	49	.84 (.58–1.19)	46	.98 (.67–1.43)	14	1.24 (.70–2.20)	47	.77 (.53–1.11)
Education								
<High school	65	1	56	1	88	1	117	1
High school +	227	.91 (.68–1.22)	204	.94 (.68–1.30)	132	.79 (.59–1.05)	248	.96 (.75–1.23)
Income ($/y)								
<15,000	60	1	41	1	71	1	87	1
≥15,000	233	.72 (.53–.96)	220	.77 (.54–1.10)	149	.74 (.55–.99)	279	.99 (.76–1.30)
Geographic center								
New Jersey	138	1	113	1	98	1	171	1
Connecticut	80	.93 (.69–1.24)	82	.91 (.66–1.24)	83	.97 (.71–1.32)	116	.88 (.67–1.15)
Western Washington state	75	.80 (.59–1.09)	66	1.12 (.81–1.55)	39	1.15 (.78–1.69)	79	1.06 (.79–1.42)
Cigarette smoking								
Never	63	1	53	1	22	1	105	1
Ever[b]	230	.86 (.64–1.16)	208	.99 (.71–1.38)	198	.99 (.62–1.59)	259	1.02 (.79–1.32)
Alcohol drinking								
Never	70	1	59	1	14	1	115	1
Ever[c]	223	1.08 (.81–1.44)	202	.87 (.64–1.18)	206	1.77 (.93–3.35)	249	1.09 (.85–1.40)
GERD								
No	135	1	164	1	174	1	232	1
Yes[d]	158	.80 (.63–1.03)	97	.74 (.56–.98)	46	1.41 (1.00–1.99)	134	.97 (.76–1.23)
NSAID use								
Never	190	1	159	1	150	1	257	1
Ever[e]	87	.86 (.65–1.13)	98	.88 (.67–1.16)	56	.79 (.57–1.11)	101	1.01 (.78–1.31)

GCA, gastric cardia adenocarcinoma; GERD, gastroesophageal reflux disease; NSAID, nonsteroidal anti-inflammatory drug.
[a]Numbers may not equal totals owing to missing exposure data.
[b]Defined as ≥1 cigarette(s)/day for ≥6 mo.
[c]Defined as ≥1 alcoholic drink (12 oz. beer, 4 oz. glass of wine, 1 drink with hard liquor) per month for ≥6 mo.
[d]Defined as symptoms of GERD (severe heartburn or acid regurgitation) at least once per week or 2 years of weekly antacid use.
[e]Defined as ≥1 tablet(s) of aspirin or non-aspirin NSAIDs per week for ≥6 months.

after diagnosis and was defined based on usual adult weight excluding the year before diagnosis. Additionally, models were adjusted for stage, limiting the potential for confounding by severity of disease.

Low income was associated with shorter survival in this population, except among OGA patients. Effects of socioeconomic status on esophageal and gastric cancer survival have been reported in some,[15,16,23] but not all[12,13] studies. The impact of socioeconomic status on survival generally is most pronounced for cancers with relatively good survival,[23,24] probably reflecting variations in access to quality health care. However, we found an independent effect of income among cancers of relatively poor prognosis, even after adjusting for stage and

Table 3. Adjusted HRs and 95% CIs for Demographic and Clinical Characteristics and Overall Survival Among Esophageal or Gastric Cancer Patients by Tumor Type in CT, NJ, and Western WA State (1993–1995 Through 2000)

	EA (n = 292)		GCA (n = 261)		ES (n = 220)		OGA (n = 361)	
	N	HR (95% CI)	N	HR (95% CI)	N	HR (95% CI)	N	HR (95% CI)
Stage								
Distant	83	1	70	1	40	1	104	1
Regional	71	.32 (.23–.45)	120	.48 (.35–.65)	82	.49 (.33–.73)	159	.35 (.27–.46)
Localized	76	.22 (.15–.31)	34	.18 (.11–.31)	49	.40 (.26–.63)	70	.12 (.08–.19)
Unknown	62	.42 (.30–.60)	37	.54 (.35–.83)	49	.46 (.30–.72)	28	.47 (.29–.74)
Sex								
Men		N/A		N/A	175	1	249	1
Women					45	.57 (.39–.83)	112	.77 (.60–1.00)
BMI (kg/m^2)								
<25	104	1		N/A		N/A	184	1
25–29.9	139	.67 (.51–.88)					130	.68 (.52–.88)
30+	49	.78 (.55–1.12)					47	.90 (.62–1.31)
Income ($/y$)								
<15,000	60	1	41	1	71	1		N/A
≥15,000	232	.64 (.48–.87)	220	.62 (.43–.88)	149	.67 (.49–.91)		

NOTE. Adjusted simultaneously for the other variables included in each tumor-specific model.
GCA, gastric cardia adenocarcinoma; N/A, not applicable (variable not included in final tumor-specific model owing to model-building strategy).

treatment, suggesting factors other than access to medical care may have contributed to the higher risk for death. Our study has limited power to detect diagnostic and treatment differences, therefore treatment effects cannot be ruled out. Furthermore, lower-income groups may be understaged systematically, causing differential misclassification[24] that contributes to the inverse association with income; however, the standardized pathology review process in our study lessened the likelihood of potential misclassification.

It is possible that a larger percentage of lower-income patients may have died from competing, nonmalignant causes of death.[24] This seems unlikely because approximately 85% of gastric cancer deaths are attributable to cancer,[15] with a higher percentage likely for esophageal tumors, given their lethality. Although a greater number of comorbid conditions among poorer people could hasten death regardless of cancer-related characteristics, no data were available to address this possibility.

Limitations of our study included the inability to consider changes in characteristics after diagnosis, which may have affected survival. Treatment and insurance status data were incomplete, limiting our ability to examine access-to-care issues fully. Any conclusions regarding the impact of these characteristics on survival should be tempered by the small absolute effects for most variables. Despite decreased HRs for localized stage and higher income, increases in survival time were, at most, 7.5 and 4 months, respectively. Another potential problem was lead-time bias from earlier detection in higher-income patients, but this seems an unlikely explanation

because these tumors are not amenable to systematic population-wide screening and the stage distribution did not show greater spread among those with lower income.

The strengths of this study include its large population-based sample of incident cases, its capacity to examine histologically confirmed subtypes of esophageal and gastric cancer, and the use of interview data to evaluate risk factor data as predictors of survival.

In summary, this cohort study of patients participating in a case-control study of subtypes of esophageal and gastric cancer revealed that stage is a strong predictor of survival, whereas income, sex, and BMI before diagnosis are moderately predictive of survival. Age, education, and other prediagnostic factors including tobacco and alcohol use, nonsteroidal anti-inflammatory drug use, and gastroesophageal reflux disease symptoms were not predictors of survival. Further investigations into causal exposures and pathways of tumor onset and progression will increase opportunities to uncover more effective strategies for preventive and therapeutic interventions.

References

1. Terry MB, Gaudet MM, Gammon MD. The epidemiology of gastric cancer. Semin Radiat Oncol 2002;12:111–127.
2. American Cancer Society. Cancer facts & figures. Atlanta, GA: American Cancer Society, 2004.
3. Farrow DC, Vaughan TL, Hansten PD, et al. Use of aspirin and other nonsteroidal anti-inflammatory drugs and risk of esophageal and gastric cancer. Cancer Epidemiol Biomarkers Prev 1998;7:97–102.
4. Farrow DC, Vaughan TL, Sweeney C, et al. Gastroesophageal reflux disease, use of H2 receptor antagonists, and risk of esoph-

ageal and gastric cancer. Cancer Causes Control 2000;11: 231–238.

5. Gammon MD, Schoenberg JB, Ahsan H, et al. Tobacco, alcohol, and socioeconomic status and adenocarcinomas of the esophagus and gastric cardia. J Natl Cancer Inst 1997;89:1277–1284.

6. Mayne ST, Risch HA, Dubrow R, et al. Nutrient intake and risk of subtypes of esophageal and gastric cancer. Cancer Epidemiol Biomarkers Prev 2001;10:1055–1062.

7. Chow WH, Blaser M, Blot WJ, et al. An inverse relation between cagA+ strains of Helicobacter pylori infection and risk of esophageal and gastric cardia adenocarcinoma. Cancer Res 1998; 58:588–590.

8. Chow WH, Blot WJ, Vaughan TL, et al. Body mass index and risk of adenocarcinomas of the esophagus and gastric cardia. J Natl Cancer Inst 1998;90:150–155.

9. Farrow DC, Vaughan TL. Determinants of survival following the diagnosis of esophageal adenocarcinoma (United States). Cancer Causes Control 1996;7:322–327.

10. Maguire A, Porta M, Sanz-Anquela JM, et al. Sex as a prognostic factor in gastric cancer. Eur J Cancer 1996;32A:1303–1309.

11. Cella DF, Orav EJ, Kornblith AB, et al. Socioeconomic status and cancer survival. J Clin Oncol 1991;9:1500–1509.

12. Vagero D, Persson G. Cancer survival and social class in Sweden. J Epidemiol Community Health 1987;41:204–209.

13. Schrijvers CT, Coebergh JW, van der Heijden LH, et al. Socioeconomic variation in cancer survival in the southeastern Netherlands, 1980–1989. Cancer 1995;75:2946–2953.

14. Bako G, Ferenczi L, Hanson J, et al. Factors influencing the survival of patients with cancer of the stomach. Clin Invest Med 1985;8:22–28.

15. Fontana V, Decensi A, Orengo MA, et al. Socioeconomic status and survival of gastric cancer patients. Eur J Cancer 1998;34: 537–542.

16. Kato I, Tominaga S, Ikari A. The role of socioeconomic factors in the survival of patients with gastrointestinal cancers. Jpn J Clin Oncol 1992;22:270–277.

17. World Health Organization. Physical status: the use and interpretation of anthropometry: report of a WHO Expert Committee. Geneva, Switzerland: WHO, 1995.

18. Ries L, Eisner M, Kosary C, et al. SEER cancer statistics review, 1973–1999. Bethesda, MD: National Cancer Institute, 2002.

19. Barchielli A, Amorosi A, Balzi D, et al. Long-term prognosis of gastric cancer in a European country: a population-based study in Florence (Italy). 10 year survival of cases diagnosed in 1985–1987. Eur J Cancer 2001;37:1674–1680.

20. Hajian-Tilaki KO. Factors affecting the survival of patients with oesophageal carcinoma under radiotherapy in the north of Iran. Br J Cancer 2001;85:1671–1674.

21. Dhar DK, Kubota H, Tachibana M, et al. Body mass index determines success of lymph node dissection and predicts the outcome of gastric carcinoma patients. Oncology 2000;59:18–23.

22. Calle EE, Rodriguez C, Walker-Thurmond K, et al. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. N Engl J Med 2003;348:1625–1638.

23. Kogevinas M, Porta M. Socioeconomic differences in cancer survival: a review of the evidence. In: Kogevinas M, Pearce N, Susser M, et al, eds. Social inequalities and cancer. Volume 138. Lyon: IARC Scientific Publications, 1997:177–183.

24. Auvinen A, Karjalainen S. Possible explanations for social class differences in cancer patient survival. In: Kogevinas M, Pearce N, Susser M, et al, eds. Social inequalities and cancer. Volume 138. Lyon: IARC Scientific Publications, 1997:377–397.

Address requests for reprints to: Katrina F. Trivers, MSPH, Department of Epidemiology, University of North Carolina at Chapel Hill, CB #7435, Chapel Hill, North Carolina 27599-7435. e-mail: trivers@unc.edu; fax: (919) 843-4752.